Small Airplanes

More Questions & Answers About Small Airplanes

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Cockpit Controls

Can I put non-flight control switches on control wheels?
The FAA has no rule preventing this, but we consider it to be against Industry Best Practice, since a non-flight control switch could be confused with an autopilot disengage or Comm System switch. Approval would require special crew training and AFM guidance.

A single power lever does not meet the rules. How can it be certified in a small airplane?

- 23-17 provides an Equivalent Level of Safety finding for approval of a single lever power control in small airplanes.

What is the FAA policy on portable electronic devices in the cockpit?

- 91.21-1 provides guidance for use of portable electronic devices.
- 120-76 provides guidance for the use of electronic flight bag devices.

What is the FAA policy on the use of the color red on electronic displays in the cockpit?
The color red should be used judiciously for items that require immediate pilot action. Also, color schemes that are commonly used by Flight Information Services in the cockpit should be consistent with the existing color schemes used when the information is presented during pre-flight and flight planning to avoid confusion.

Crashworthiness/Interiors

What is the most relevant TSO for seat dynamic testing?
TSO-C127a Rotorcraft, Transport Airplane, And Normal And Utility Airplane Seating Systems. Note that TSO-C127a refers directly to Society of Automotive Engineers (SAE) Aerospace Standard AS8049, Rev A, dated September 1997.

Where can I secure a copy of AS8045, Rev A?
This Aerospace Standard is available for a fee through SAE. You may place an order for this document by contacting them at (412)776-4970) or visit their website at http://www.sae.org

Can I just use analysis to certificate my new seats?
No, compliance to 14 CFR Section 23.562. for new/baseline seats is only possible by dynamic testing.

I have many questions on dynamic testing, what document should I examine first?
You should first read and study 23.562-1. . It covers most of the technical issues you will face in testing. Additional information is available in SAE AS8045 Rev A. Your ACO will also be a good source of information.

Flight Controls

A single power lever does not meet the rules. How can it be certified in a small airplane?

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Can I put non-flight control switches on control wheels?
The FAA has no rule preventing this, but we consider it to be against Industry Best Practice, since a non-flight control switch could be confused with an autopilot disengage or Comm System switch. Approval would require special crew training and AFM guidance.

Small Airplanes

More Questions & Answers About Small Airplanes

Fuels

There are no specific rules under Title 14 that regulate the fuels themselves. These rules regulate the use of fuel in a particular engine or aircraft.

- Aviation Fuels regulations & policies
- Aviation Fuels Resources
  - Aviation gasoline (AVGAS)
    In the United States of America and Canada, the widely accepted standards for aviation gasoline are ASTM International Standards
    - D-6227 - Standard Specification for Grade 82 Unleaded Aviation Gasoline
    - D-910 - Standard Specification for Aviation Gasoline
  - Turbine Fuel
    In the United States and Canada, the widely accepted standards for Turbine Engine fuels are ASTM International Standards
    - D-1655 - Standard for Specification for Aviation Turbine Fuels
    - D-6615 - Standard Specification for Jet-B Wide-Cut Aviation Turbine Fuel

How does the FAA regulate the production and distribution of Aviation Fuels?
The FAA does not directly regulate this, but depends instead on the ASTM International Organization and its rigorous consensus process for the development, revision, and prosecution of standards for production and quality. The FAA actively participates in this process along with representatives from manufactures, users, consumers, and researchers in the fuels arena. Historically, engine manufacturers have also used military standards and designations to specify allowable fuels.

How do I determine what fuel is allowed for my engine?
Each engine must be type certificated independent of any aircraft and will list the fuels approved for use in the engine as part of its Type Design Data Sheet (TCDS). As part of the certification of the airplane using that engine, there are requirements to list the approved fuels in the Airplane TCDS, the Airplane Flight Manual, and on placards at the fuel filler ports on the airplane.

Is it possible for me to use Automotive Gasoline in my aircraft?
Certification is required for this change in operation. Supplemental Type Certificates (STC) have been issued for using Automotive Gasoline in different airplanes. Contact the holders of the STC for your airplane model for further information. In addition, view the Regulations & Policies for Aviation Fuels for further information.

What is the difference in how engines and engine installations are certified relative to fuel?
FAA approval to use fuel in a particular aircraft model is a two-step process.

1. The engine model must undergo certification to operate on the fuel.

   Engines are certificated under Title 14, Part 33 of the Code of Federal Regulations (CFR). These rules cover the design and operation of the engine independent of any aircraft systems and consider such things as engine operating characteristics and engine fuel system component compatibility with the fuel(s).

2. The aircraft and engine installation must be certified to operate with the fuel.

   Engine installations in aircraft are certificated under Title 14, Parts 23, 25, 27, and 29 of the CFR. These rules cover the design and operation of an engine as integrated into an aircraft and consider such things as the aircraft fuel system component compatibility with the fuel(s), aircraft performance, and aircraft structural considerations.

Small Airplanes

More Questions & Answers About Small Airplanes

Icing Protection Systems

My airplane has some ice protection systems installed but is not certified for flight in icing. A later model of my airplane, which is on the same Type Certificate Data Sheet, is certified for flight in icing in accordance with § 23.1419. The later model does have a different engine installed with higher horsepower and a different ice protection system. Can I install the same ice protection systems as the later model, install a new engine with at least the same horsepower, and be certified for flight in icing?
Yes, and similarity may be used to show compliance to the applicable regulations. However, there may be some testing required. The current method of compliance to § 23.1419 includes tests (susceptibility to ice contaminated tailplane stall, for example) that may not have been accomplished during certification of the later model.

Can I install an ice protection system on my airplane and use it just for inadvertent icing encounters (I don't want to certify it for flight in icing conditions)?
These installations have been approved, see 23.1419-2 Certification of Part 23 Airplanes for Flight in Icing Conditions, for guidance on certificating these systems. For operational information and limitations of these systems, see the Safety Advisory "Aircraft Deicing and Anti-Icing Equipment" published by the AOPA's Air Safety Foundation and 91-74 Pilot Guide: Flight in Icing Conditions.

Why must ice accretion on protected surfaces be considered for icing certification?
Significant ice amounts can accrete during the "rest" time of deicing boots. This is called "intercycle" ice. One can see photos of intercycle ice on a typical general aviation wing leading edgeand aerodynamic penalties in 20-73 Aircraft Ice Protection. Additional intercycle data and residual ice data (ice that remains on the boots after a deicing cycle) on lower airspeeds associated with most general aviation airplanes is in conference paper AIAA 2007-1090, "Residual and Intercycle Ice for Lower-Speed Aircraft with Pneumatic Boots", 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 January 2007, Reno, NV. This AIAA paper also has data on runback ice accretions that can form on and behind pneumatic boots in part 25, Appendix C icing conditions .

I'm confused as to when to activate my pneumatic deicing boots – I heard that activating them too soon will result in the ice "bridging" over the inflated boot resulting in poor ice shedding?
Please follow the procedures in your AFM. Flight testing and icing tunnel testing have shown that "modern" boots do not suffer from ice "bridging." AIAA 2007-1090, "Residual and Intercycle Ice for Lower-Speed Aircraft with Pneumatic Boots", 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 January 2007, Reno, NV showed that boots may not shed ice immediately at low airspeeds, but the ice will eventually shed. Also see 91-74 Pilot Guide: Flight in Icing Conditions. The FAA in 23.1419-2 Certification of Part 23 Airplanes for Flight in Icing Conditions, recommends activating the boots at the first sign of ice accretion and equipping new airplanes with automatic timer systems. The testing in AIAA 2007-1090, "Residual and Intercycle Ice for Lower-Speed Aircraft with Pneumatic Boots", 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 January 2007, Reno, NV showed that the application of the manufacturer's ice adhesion product improved ice shedding and reduced the amount of residual ice. This is backed up by anecdotal data. So make sure this product is applied per your maintenance manual prior to flight in forecast or known icing.

Small Airplanes

More Questions & Answers About Small Airplanes

How are icing conditions outside of Appendix C, freezing drizzle and freezing rain for instance, being addressed by the Small Airplane Directorate for airplane certification?
The Ice Protection Harmonization Working Group is currently defining this environment, drafting a new rule, and drafting guidance material for Part 25 airplanes. The Small Airplane Directorate will determine what rules and guidance will flow down to Part 23 Airplanes. In the interim, see 23.1419-2 Certification of Part 23 Airplanes for Flight in Icing Conditions, for information that should be put in the AFM regarding this environment, and information on roll control and stall warning in this environment.

Landing Gear

- Policy for Replacement/modification parts in aircraft brakes can be found in 23-17, Section 23.735.

Do I need to do worn brake testing for a part 23 airplane?
No, there is no rule in part 23 that requires worn brake testing. An applicant may do such testing at their option. If so, there is guidance in 23-17, Section 23.735.

Do I need to do rejected takeoff testing for part 23 airplanes?
Only if the project is for a commuter category airplane

Lights

Are external lights required?
The part 23 rules above provide standards for external lights that are installed on small airplanes. The requirements to install lights other than anticollision lights are in the operational rules such as part 91, Section 91.205. Anticollsion lights are required by part 23, Section 23.1401 for planes with a certification basis before Amendment 23-49 when night VFR or IFR is requested, and for all planes with a certification basis of Amendment 23-49 and Subsequent.

Can a plane have both aviation white and aviation red anticollision lights installed?
Yes. But, the light in any one direction must be either red or white.

Normal, Utility, & Acrobatic Airplanes

What is the difference between normal, utility, and acrobatic category airplanes?
The specific differences are provided in 14 CFR Section 23.3. The differences are based upon the types of flight maneuvers the airplane is approved to perform.

Does a normal, utility, or acrobatic category airplane meet a "lower level of safety" than transport or commuter category airplanes?
This is an over-simplification of the basis for the FAA requirements. The FAA requirements are based upon the operations, service histories, and designs of types of airplanes. Normal, utility, and acrobatic category airplanes have typically been of simple design and construction, allowing some simplified certification requirements. Also, the designs are limited due to items such as single engines. Additionally, pilot training requirements for the vast majority of these airplanes is much less than transport pilots.

Due to such design and operational limitations, more stringent criteria such as low stall speeds for single engine airplanes and cockpit design are applied than are applied to transport and commuter category airplanes. At the same time, less stringent criteria may be applied to items such as systems integration since the designs may be limited by the types of systems that can be installed. The FAA design standards are based upon the nature of the design, operation, and service history of the airplanes.

My airplane is of simple construction, with basic mechanical systems, and with a normally aspirated, reciprocating engine with plenty of safe service history. It will meet all applicable Part 23 requirements; however, its more than 12,500 lbs. In light of the preceding question, why can't I certificate this airplane as a normal category airplane?
As stated in 14 CFR Section 23.3, a normal category airplane can only have a maximum certificated weight of 12,500 lbs; therefore, the airplane would not meet the definition of normal category. However, you always have the option of pursuing a restricted category airplane or even trying to get an exemption to the weight requirement in Part 23. All such options should be discussed with the FAA as early as possible to ensure the appropriate actions are taken.

Oxygen Systems

Must a type design include oxygen system data?
Before Amendment 23-43, 14 CFR Section 23.1441 stated "If certification with supplemental oxygen equipment is requested." Amendment 23-43 states "If certification with supplemental oxygen equipment is requested, or the airplane is approved for operations at or above altitudes where oxygen is required to be used by the operating rules. Therefore, an unpressurized plane should have an approved oxygen system or be limited to altitudes where supplemental oxygen is not required."

What about a pressurized airplane?
Pressurized airplanes may use cabin pressure warning with Time of Useful Consciousness to allow descent to non-oxygen altitudes after a pressurization failure.

Can I use portable systems?
Part 23 allows portable oxygen systems to be used. In this case, type design data must include the portable oxygen bottles as items of mass in emergency landing loads per Section 14 CFR Section 23.561.

Powerplant

Powerplant - Controls

Can I use single power levers?
Yes, with an Equivalent Level of Safety (ELOS)

Can I use Full Authority Digital Engine Controls (FADEC)?
Yes, with High Intensity Radiated Fields (HIRF) special conditions (23.1309-1. Compliance). Another reference is

- 20-135 Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria.
- 20-136 Protection of Aircraft Electrical / Electronic Systems Against the Indirect Effects of Lightning.
- 23-2 Flammability Tests.
- 33.28-1 Compliance Criteria for 14 CFR §33.28, Aircraft Engines, Electrical and Electronic Engine Control Systems.
- 33.28-2 Guidance Material for 14 CFR 33.28, Reciprocating Engine, Electrical and Electronic Engine Control Systems.
- 14 CFR Section 23.777 Cockpit controls.
- 14 CFR Section 23.779 Motion and effect of cockpit controls.
- 14 CFR Section 23.781 Cockpit control knob shape.

Powerplant - Cooling Systems

What mixture setting should I use for the cooling climb test on reciprocating engines?
The setting should be the leanest per the manufacturer. This is usually found in the engine model specifications.

Powerplant - Fire Protection

What is the difference between fireproof and fire resistant?
The difference is in the duration that the material of component should maintain its integrity or perform its function. A fire resistant material or component will function and maintain its integrity for a minimum of 5 minutes when exposed to a 2000 degree F flame. A fireproof material or component will function and maintain its integrity for a minimum of 15 minutes when exposed to a 2000 degree F flame.

What are the general principles and objectives of powerplant fire protection?
The main principles of powerplant fire protection are hazard prevention, zonal containment, detection, and extinguishing. The objective of the rules is to ensure that the installation of the engine(s) and their associated components is designed to prevent the occurrence and spread of fire and to preclude addition hazards arising from a fire in a designated zone.

Powerplant - Foreign Object Ingestion

- 33-1 Turbine Engine Foreign Object Ingestion and Rotor Blade Containment Type Certification Procedures.
- 33-2 Aircraft Engine Type Certification Handbook.
- TSO-C77b Gas Turbine Auxiliary Power Units.

What does the acronym FOD mean?
FOD stands for Foreign Object Damage. Relative to propulsion systems, this term is used to describe damage to the engine inlets, probes, engine interior rotating parts such as fan and compressor blades, or propellers that occurs when ingesting items other than air. Examples of such items include gravel, ice, runway debris, birds, etc.

Does the type certification of a propeller account for any foreign object damage requirements?
Propeller type certification does not include any type of foreign object damage requirements, unless accomplished with special conditions or special tests.

Can the part 33 engine certification be used to comply with the part 23 rules for foreign object ingestion and damage?
The part 33 engine certification can be used as a basis for complying with the part 23 rules. However, per § 23.901, the capability of the engine installation to withstand foreign object ingestion must not be less than that of the certificated engine.

Powerplant - Oil Systems

- 20-135 Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria.
- 23-2 Flammability Tests.
- 23-16 Powerplant Guide for Certification of Part 23 Airplanes and Airships.

Powerplant - Operability

Information pertaining to powerplant operability

- 33.28-1 Compliance Criteria for 14 CFR §33.28, Aircraft Engines, Electrical and Electronic Engine Control Systems.
- 33.78-1 Turbine Engine Power-Loss and Instability in Extreme Conditions of Rain and Hail.
- Multiengine Requirement for Part 23, Commuter Category Airplanes (PDF)

What is the definition of powerplant operability?
The condition where the engine(s) and its associated systems and components exhibit proper behavior within their documented limitations while they are in use. Examples of operability conditions and limitations include restart envelopes, engine temperature limits, engine speed limits, surge and stall margin, fuel control run-down margin, and combustor flameout margin.

Powerplant - Propellers

Can I install a different propeller on my airplane?
Yes, provided it is a certified propeller and is compatible with your installation.

Information pertaining to Propellers

- 20-88 Guidelines on the Marking of Aircraft.
- 23.1419-2 Certification of Part 23 Airplanes for Flight in Icing Conditions.
- 35.37-1 Guidance Material for Fatigue Limit Tests and Composite Blade Fatigue Substantiation.
- 14 CFR Section 23.33 Propeller speed and pitch limits.
- PS-ACE100-2002-008 Propeller Testing Vd Versus VNE].

Powerplant - Reversing Systems

- 14 CFR Section 23.777 Cockpit controls.
- 14 CFR Section 23.779 Motion and effect of cockpit controls.

Small Airplanes

More Questions & Answers About Small Airplanes

Powerplant - Subpart E

Can the part 33 Engine and part 36 Propeller certification be used to comply with the part 23 rules for powerplant installation?
The part 23 rules cover the integration of the engine and propeller with the airframe, and compliance must be shown for these rules separate from the engine and propeller rules in part 33 and 35 respectively. The certificated engines, propellers, and components that are part of certificated engines and propellers are considered part of the powerplant installation. As such, any findings of compliance with part 23 requirements should take maximum advantage of the relevant findings made in support of part 33 or 35. It is important to identify and accommodate all engine and propeller certification dependencies with the aircraft installation to ensure compatibility of the hardware and operational limitations.

Is it possible to affect the type certificate of the engine by its installation in an airplane?
Part 23 rules require compliance with the engine manufacturer's installation drawing, installation manual, and engine specific operating instructions. Non-compliance with the engine manufacturer's installation requirements can invalidate the type certification status of the engine, making the engine non-compliant with § 23.903(a)(1). For example, compliance with part 34, Fuel Venting and Exhaust Requirements for Turbine Engine Powered Airplanes, should be documented on the engine type certificate, and it is possible for an engine installation to invalidate compliance with this part.

Is it possible to affect the type certificate of the propeller by its installation in an airplane?
Part 23 rules require each propeller to be type certificated to part 35 rules and that the installation not exceed the limits of the certificated propeller. Exceeding these limits or adding additional components to the propeller as part of the installation can invalidate the type certification status of the propeller, making the engine non-compliant with §23.905(a). For example, installation of a propeller on an airplane with an engine that produces rotational speeds higher than those allowed on the propeller could invalidate the propellers certificate as used on that airplane.

Pressurization

14 CFR Section 23.841 requires a warning when the cabin pressure exceeds 10,000 feet. This is a nuisance warning since the pressurization system often permits a cabin pressure greater than 10,000 feet. What are my options?
The FAA has approved an Equivalent Level of safety finding for a system with an amber light at 10,000 feet and a warning (red light) when the cabin pressure exceeds 12,500 feet when the pressurization system has normal operation modes (e.g. low power descents) where cabin pressure will exceed 10,000 feet.

Recording Systems

What part 23 airplanes require CVR and FDR?
14 CFR Section 23.1457 and 14 CFR Section 23.1459 both apply to recording equipment "required by the operating rules of this chapter" so they are applicable per 14 CFR Section 91.609, 14 CFR Section 135.151, 14 CFR Section 135.152, and Thus, commuter category planes used in commuter operations are the only part 23 planes where CVR's and FDR's are required.

How do I choose the electrical bus to power recording devices?
While recording devices are valuable in accident investigations, they are non-essential equipment in operation of an airplane. Both 14 CFR Section 23.1457 and 14 CFR Section 23.1459 acknowledge this by requiring they be put on the most reliable electrical bus that does not jeopardize essential or emergency loads. Also see TSO-C155 Recorder Independent Power Supply.

Software

Because software engineering/development is essentially a "common" aspect of modern aircraft electronic systems, the associated policy & guidance applicable to obtaining approvals for Part 21/23/25/27/29/33 aircraft software are kept in strict alignment with FAA National Policy. As a result, the dissemination of software specific policy and guidance is managed/coordinated by FAA Headquarters in Washington, D.C. The following sections provide additional information available regarding software approval requirements as applicable to Part 23 aircraft.

Is there any material which may provide information relative to gaining FAA software approval?
Yes, the predominant means of compliance (MOC) to gain FAA software approval, as recognized in 20-115, is via following the processes of "RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification" dated December 1, 1992. This MOC can also be used for approval of the logic aspects (i.e., software) of Complex Electronic Hardware (CEH, such as Programmable Logic Devices). However, a more appropriate MOC for CEH is found in the processes contained in "RTCA DO-254, Design Assurance Guidance for Airborne Electronic Hardware" issued on April 19, 2000. Both of these documents can be purchased from:

RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036-4008

Or by fax: 202-833-9434

Or via the internet at RTCA Website

Is there any other material or links which may be useful?

- FAA Aircraft Certification Service Software Homepage

Very Light Airplanes

What is the difference between AC 21.17-3 and AC 23-11A?
21.17-3 provides guidance on the rules governing the certification of JAR-VLA airplanes in general. For example, it provides guidance on obtaining a special category type certificate for Day Visual Flight Rule operations only, how to obtain a primary category TC, and when an applicant would need to pursue a part 23 TC (Night VFR or Instrument Flight Rules). 23-11 offers guidance to those applicants who wish to pursue a part 23 TC. Per the guidance in AC 21.17-3, any JAR-VLA airplane that seeks Night VFR or IFR operations must obtain a part 23 TC. AC 23-11 offers guidance on how to obtain that TC.

I am seeking a part 23 TC for my JAR-VLA airplane. What should I do?
You should be prepared to show compliance to all required part 23 rules. You are encouraged to read 23-11 for guidance on the part 23 TC process and those part 23 rules that are complicated or frequently misunderstood.

Small Airplanes

More Questions & Answers About Small Airplanes

What happened to the original JAR-VLA/Part 23 AC, AC 23-11?
We cancelled it. Applicants were misunderstanding the intent of numerous sections of this AC. They believed that the physical characteristics of their airplane entitled them to a positive Equivalent Level of Safety finding to numerous part 23 rules. We felt the best solution to this was to rewrite AC 23-11 and cancel the original document.